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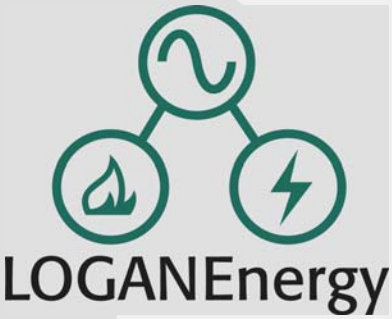

United States Coast Guard Operations Facility PEM Fuel Cell Demonstration Project
United States Coast Guard Station, New Orleans, Louisiana
Final Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY01

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New Orleans, Louisiana

May 27, 2004

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Executive Summary

In May 2003, LOGANEnergy Corporation received a contract modification to its CERL BAA FY01 PEM Demonstration contract award that added the US Coast Guard Operations Center in New Orleans, LA to its project sites. LOGAN completed the installation of one Plug Power GenSys5C fuel cell at the station as part of the CERL PEM demonstration Program and started the unit on August 22, 2003. However, the Demonstration Period did not commence until October 27, 2003 because of delays in acquiring high-speed commercial Ethernet service for the Web SCADA system. The project concluded its performance testing and evaluation on April 30, 2005 achieving 94% availability over a 12 month period. During the last 7 continuous months of operation the fuel cell achieved 98% availability, an impressive statistic.

The Combined Heat and Power installation operates electrically in a grid parallel/grid independent configuration that ties several kitchen appliances and convenience outlets onto the fuel cell's critical load panel. The facility's hot water heater captures the unit's waste heat output. The installation is instrumented with an external wattmeter, thermocouples, a water flow meter, and a gas flow meter. A phone line is connected to the power plant communication's modem providing bi-directional communications with factory technical service, to improve remote trouble shooting and service dispatches. In addition, this site hosts LOGAN's first online data gathering and management system that provides real time operational control, data collection, resource management and alarming.

The Point of Contact for this project is Petty Officer George Dunn. He may be reached at (504) 846-6181. The total estimated energy cost premium to the host site as a result in participating in this demonstration project is -$94.42.

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1.0 Descriptive Title

United States Coast Guard Operations Facility PEM Demonstration Project, United States Coast Guard Station, New Orleans, Louisiana

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is scott_wilshire@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel

Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 North side
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Contract: Four-year PC25 PM Services Maintenance Agreement.
In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability. LOGAN performs the quarterly and annual service prescribed by the UTC, and performs other maintenance as required. The periods of unavailability are chiefly due to persistent inverter problems that seem to be endemic to the Toshiba power conditioning balance of the system. Field modifications and operating adjustments have largely cured the problem. Quarterly service events take 10 hours to complete with the unit under load, and the annual event takes approximately 35 hours with the unit shut down.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD.

Plug Power
Mr. Scott Wilshire.
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

LOGAN performed the start-up of both units after Southern Maryland Electric Cooperative completed most of the installation work. The units are located at residential sites at Patuxant River Naval Air Station, VA and operate in standard gird connected/grid independent configurations. Both operate at 4.5kWe and have maintained 98% availability. The units, S/Ns 241 and 242 are two of the very latest

GenSys models to reach the field. S/N 242 is Plug Power's first LPG fueled system to go into the field. Both have set a new level of performance expectations for this product, and are indicative of the success of the various test and evaluation programs that have been conducted over the past two years.

c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement.

Mr. Ron Allison
A Partners LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

On April 20, 2004 LOGAN completed the installation of a 600kWe PC25C CHP fuel cell installation in Fresno, CA. The system operating configurations allow for both grid parallel and grid independent energy service. The grid independent system is integrated with a multi unit load sharing electronics package and static switch, which initial development was funded by ERDC CERL in 1999. This is the third fuel cell installation that uses the MULS System. The thermal recovery package installed in the project includes a 100-ton chiller that captures 210 degree F thermal energy supplied by the three fuel cells to cool the first three floors of the host facility. The fuel cells also provide low-grade waste heat at 140 degrees F that furnishes thermal energy to 98 water source heat pumps located throughout the 12-story building during the winter months.

7.0 Host Facility Information

The U. S. Coast Guard Station, New Orleans, is located in Metairie, Louisiana, on the south shore of Lake Pontchartrain. The Station maintains a 24-hour operational capability to support launches and recoveries of U.S. Coast Guard Sea-Air Rescue, U.S. Customs Alert, and 159th Fighter Group/Louisiana Air National Guard. Entergy provides the station's electricity and natural gas.

8.0 Fuel Cell Installation

In February 2003, representatives from LOGANEnergy met with Petty Officer George Dunn at the US Coast Guard Operations Center in New Orleans to confirm the commands previously expressed interest in hosting a 5 kW PEM Fuel Cell demonstration unit at the facility. Mr. Dunn expressed strong interest on behalf of the station commander to participate in the PEM program. In May of 2003, LOGAN received supplemental funding under its FY'01 PEM contract to proceed with the PEM Demonstration at the Coast Guard Station. In early June 2003, LOGAN and CERL conducted the project kick-off meeting at the facility with Coast Guard representatives to cover the objectives of the project and to finalize the installation plan. Plug Power shipped GenSys SN#196 fuel cell to the Coast Guard facility in early July 2003, and on August 27, 2003, LOGAN started the unit for the first time. With connection of the Ethernet service on October 27, 2003 real time data became available and the project officially commenced. The installation is unique because the fuel cell sits on a second story deck of the operations facility. Figure 1, below, shows the fuel cell on its pad on the second level deck of the Coast Guard Operations Center. The fuel cell was partially disassembled to accommodate the weight restrictions on the service elevator, and then rolled into place with a hand truck and dolly, then rigged

onto its footings with the assistance of fork truck. Also noted on the wall are the fuel cell de-ionized water panel and electric meter.

Figure 1, Fuel Cell Located on Second Story

Figure 2, below, diagrams the fuel cell installation with utility interfaces including, natural gas, power and water supply for the site. While operating at 2.5 kW for the duration of the test period the fuel cell will consume 3,500SCFH of natural gas, equating to approximately 25% electrical efficiency. The installation includes LOGAN's first Ethernet communications system designed by Connected Energy Corporation for the project. Note how data wiring from several source outputs are routed to the web interface control panel. The information is transmitted via the web to Connected Energy's data center in Rochester, New York, where it is formatted for display on several control and data management screens.

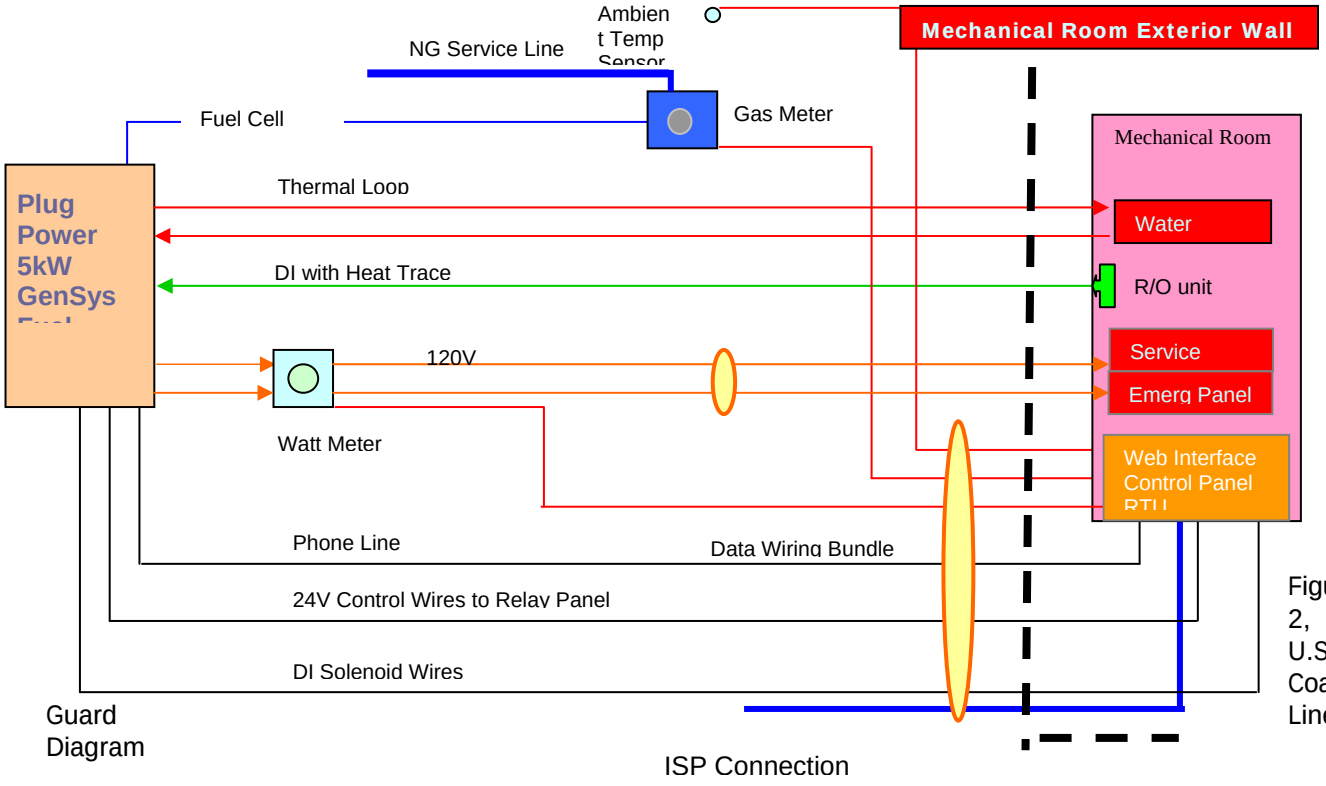


Figure 2, U.S. Coast Line

LOGAN's contractor procured electrical and plumbing permits that were necessary to construct the site. Neither air quality permits nor grid interconnect permits were necessary to complete the project.

9.0 Electrical System

The Gensys5C fuel cell at this site has the new MP5 inverter that has a power output of 110/120 VAC at 60 Hz, matching the facility's distribution panel located in the mechanical room with its connected loads at 110/120 VAC. The inverter permits the fuel cell installation to operate in both a grid parallel/grid independent configuration as shown in Figure 3, below. The installation circuitry includes a two-pole wattmeter that records fuel cell power over both the line and load conductors. These are wired to the existing service panel and the new critical load panel installed in the equipment room, respectively. A double throw service disconnect, installed at the meter, is an added safety feature that permits the service technician to isolate the fuel cell from the grid in order to perform maintenance without disturbing the power service to the facility. Figure 3, below, illustrates the wiring configuration that LOGAN used to accomplish this. Figure 4 below is an actual photo of the installation. Even though the fuel cell is in direct communication with the local electric grid operated by Entergy, the utility company did not register any interest or concern with the project despite repeated calls for interconnection guidance.

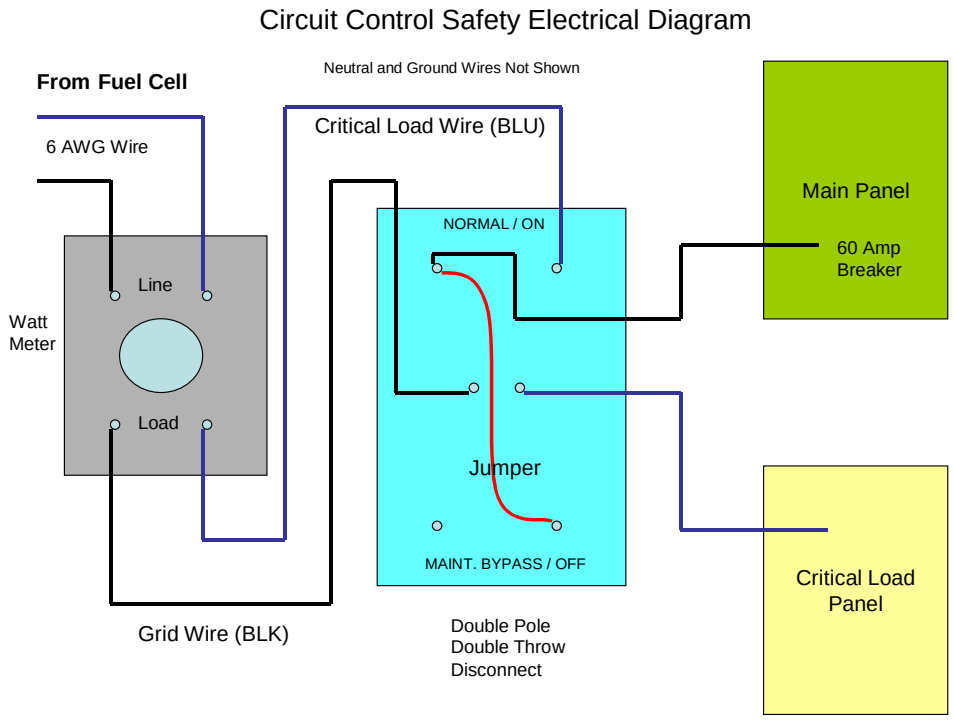


Figure 3, Electrical Line Diagram

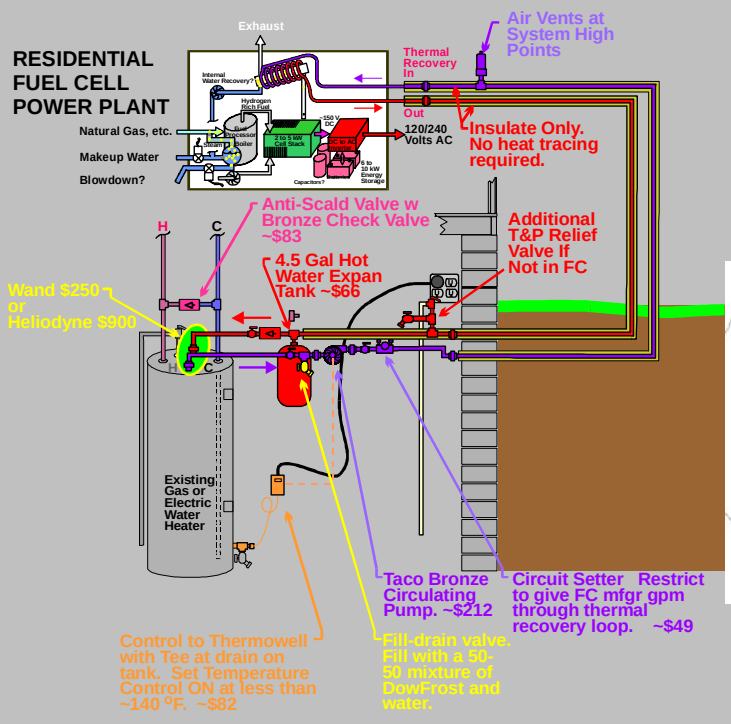
Figure 4, Panel with Electric Meter

10.0 Thermal Recovery System

In contrast to other sites, where LOGAN installed a hot water heater with indirect heating coils, this site employs a Heliodyne heat exchanger to capture fuel cell waste heat and transfer it into the facility's hot water system. The Heliodyne is a coil within a coil design, described in Figure 6 that provides double wall protection between the heat source and the heat sink in order to prevent contamination of potable water supplies. It was designed primarily for the solar heating industry, but proved to be very adaptable to this installation. In Figure 5, below, the "U" shaped Heliodyne can be seen mounted directly to the facility's existing commercial hot water heater. It has its own pump that circulates the storage tank in a counter flow against incoming hot water provided by the fuel cell's heat exchanger. While operating at a set point of 2.5 kWh, the fuel cell provides 7800 Btu/h to the storage tank at approximately 140 degrees F. Later in the project LOGAN hopes to gain the cooperation of the customer in order to thermally map the system to develop a clear picture of its effectiveness.

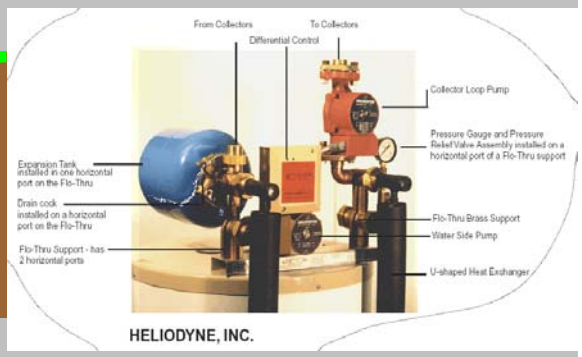
Figure 5, Thermal Recovery Installation

Heliodyne HEX Integrated With Site Water Heater



Heliodyne

- 6 feet total in "U" double wall with 2.3 sq ft copper surface w turbulent flow on tank side = 17.6 sq ft relative to RCC



Slide 5

Figure 6, Heliodyne Heat Exchanger Schematic

11.0 Data Acquisition System

Over the course of developing the several sites in the FY01 PEM Program, LOGAN has encountered great difficulty in acquiring a dedicated phone line for the fuel cell at every site. In the best case this has delayed starting the demonstration period by three weeks. Most sites have proven far more difficult. At this site, the Coast Guard was unable to provide a discrete line to the fuel cell modem for two months following the initial start. Fortunately, the new but untested Web communications system (shown at left and described below) was running intermittently during that period, but since it lacks the ability to send out a high speed data packet following a shutdown, the site was nevertheless handicapped by the unavailability of this important information needed to troubleshoot system failures. These experiences have taught LOGAN to be very explicit with the host POC at the kick-off meetings concerning the necessity for providing a dedicated phone line, since much of the success of the project is dependent upon reliable communications with the unit.

Beginning with the Coast Guard Project, LOGAN decided to experiment with a new web based, real time, data management and reporting system. To do this LOGAN contracted with Connected Energy Corporation, CEC, to provide the service. The drawing seen in Figure 8 describes the architecture of the CEC system operating at the site. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, remote notification, and reporting functions. CEC's Central Operations Control Center in Rochester, New York, collects, stores, displays, alarms, archives site data, and maintains connectivity with the site.

With the introduction of this system, LOGAN has learned a number of important lessons in the emerging world of Web based CHP asset management. Initially the Coast Guard permitted the installation to "piggyback" on its LAN in order to provide connectivity between the fuel cell and the CEC control center. To accomplish this, the control center assigned a discrete Internet Protocol (IP) address to the high-speed modem in the terminal unit (Figure 8) at the site. This permits the control center to establish a secure Virtual Private Network (VPN) link with the unit. At the same time, the Coast Guard also gave LOGAN permission to use their LAN while onsite to access the data screens. However, on December 5 2003, high-level Coast Guard Security officials cut their LAN service to the fuel cell indicating to LOGAN that the connection violated their new security protocols. From that point, until March 8, 2004 when LOGAN reconnected the site VPN via a commercial ISP account, the unit operated without being able to capture performance data. Plug Power did, however continue to receive power plant data through its daily call out to the unit. Since that experience, LOGAN has relied exclusively on commercial high-speed ISP providers.

Another important lesson that LOGAN has learned with this system is the critical role that individual instrumentation components play in supplying the data to the web interface. The CEC system requires very precise signals from the outputs of these devices. The gas meters, watt-meters, flow meters and thermal elements invariably require signal strength adjustments at the RTU terminals to insure that their discrete inputs are readable by the CEC system. Discovering the proper voltage range required for each signal loop is most often achieved by trial and error, requiring multiple site visits to establish a

readable connection. However, the field experience learning curve has been rapid, and LOGAN is building a body of knowledge and expertise with this system that will yield improved results and better data at new sites in the future. Figure 9 is an example of one of many data screens that are maintained by the CEC system and displayed on the web. Sample data graphs are also attached to Appendix 1 providing performance data for the period of October 2003 through March 2004. To view the operation of this unit online, go to: https://www.enerview.com/EnerView/login.asp

Login as: logan.user and enter password: guest. Select the box labeled 4th District Coast Guard. Then you may navigate the Coast Guard site or other sites using the tool bars or html keys.

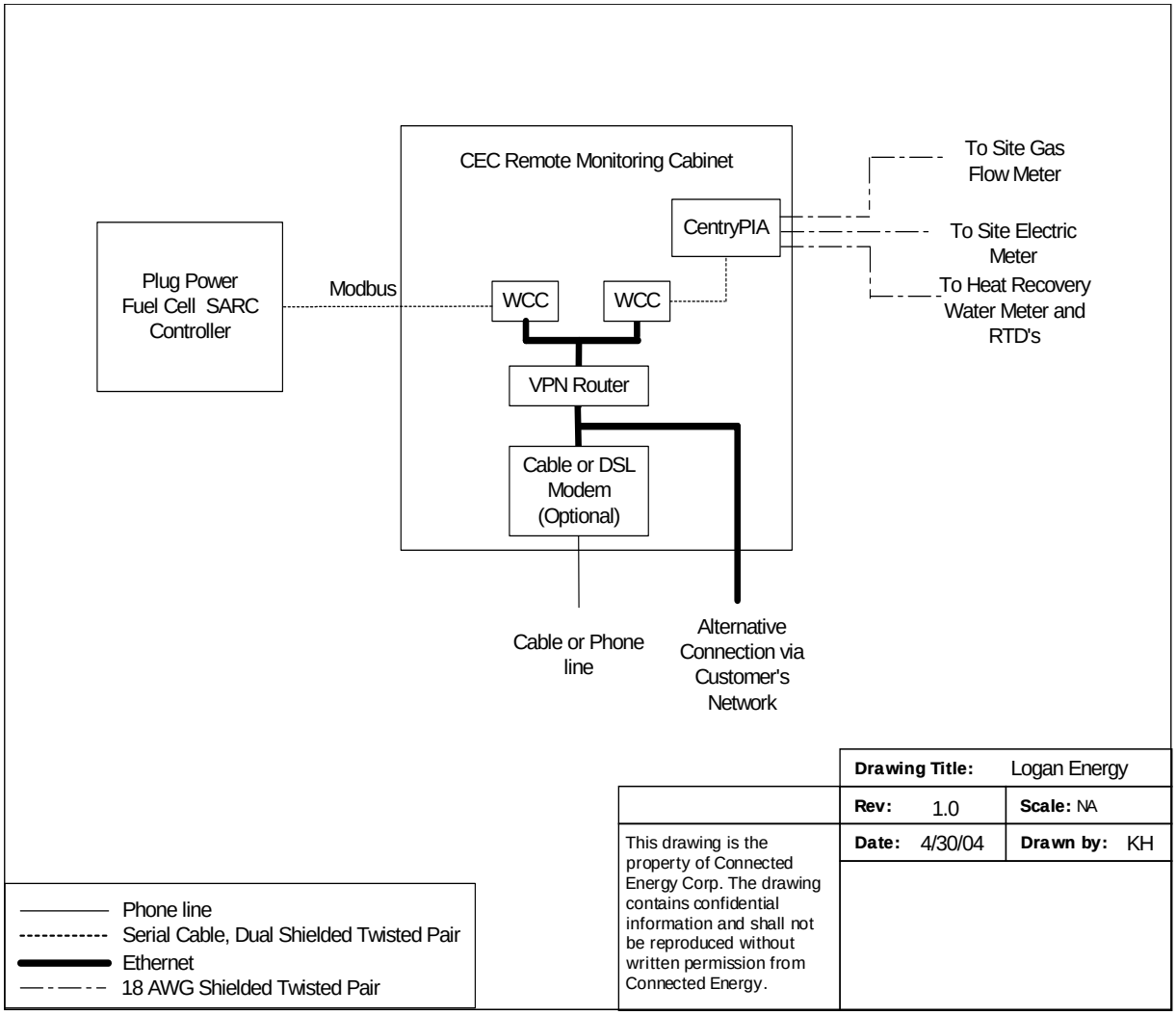


Figure 8, Connected Energy System Architecture

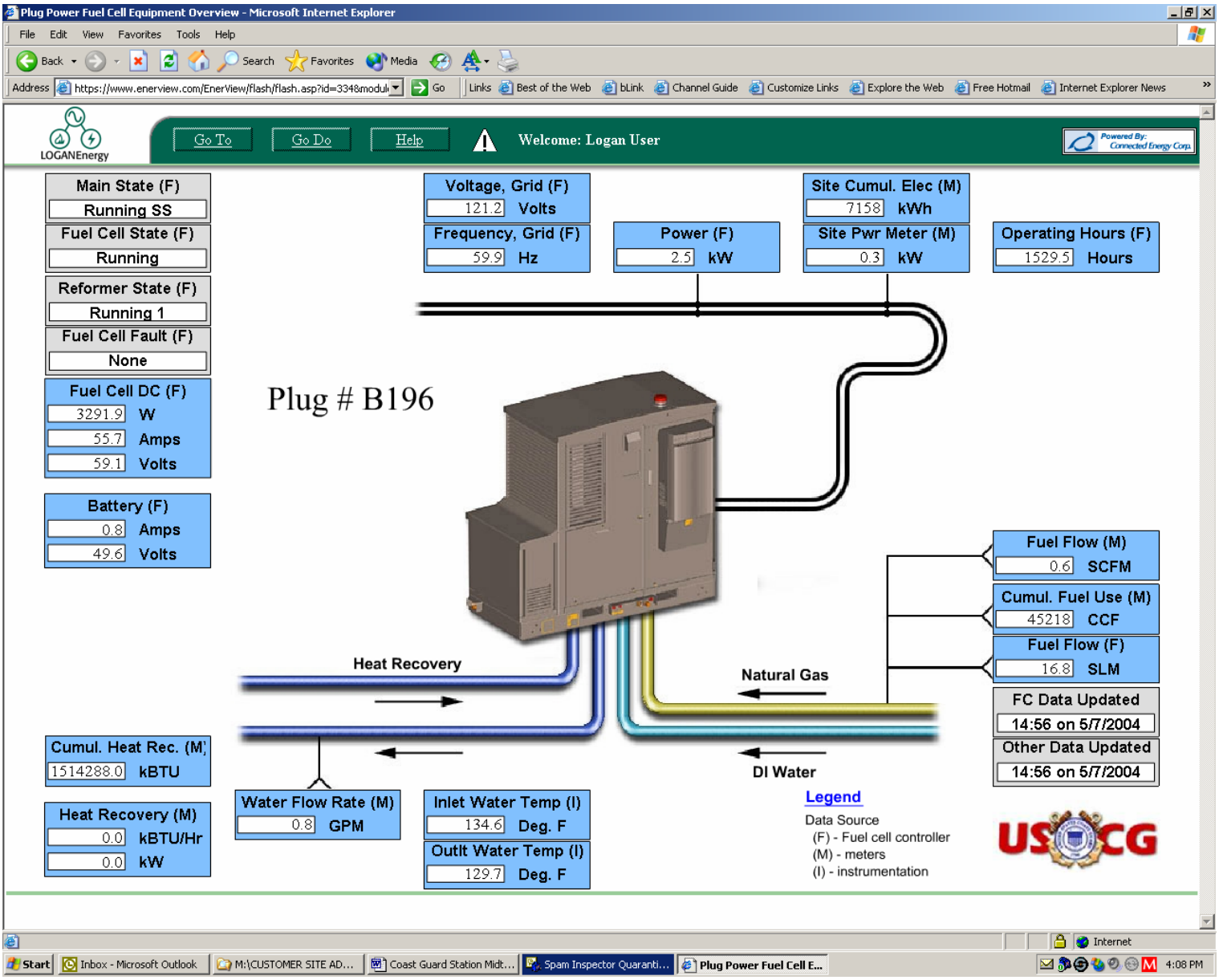


Figure 9, Connected Energy Web Based Data Display

12.0 Fuel Supply System

LOGAN connected the fuel cell gas piping into the existing gas service line adjacent to the fuel cell pad and installed a pressure regulator at the fuel cell gas inlet to maintain 10-14 inches water column (IWC) at the fuel cell inlet, and added a new gas meter on the fuel cell line to independently record the gas consumed by the fuel cell. This meter provides an output to a data-gathering terminal in the Connected Energy cabinet seen in the line diagram in Figure 2.

13.0 Program Costs

U.S. Coast Guard, New Orleans PEM Demonstration Program

Project Utility Rates	
1) Water (per 1,000 gallons)	$ 2.31
2) Utility (per KWH)	$ 0.048
3) Natural Gas (per MCF)	$ 6.58

First Cost	**Budgeted**	**Actual**	**Variance**
Plug Power 5 kW SU-1	$ 65,000	$ 65,000	**$ -**
Shipping	$ 1,800	$ 1,500	**$ (300)**
Installation electrical	$ 4,200	$ 2,182	**$ (2,018)**
Installation mechanical & thermal	$ 3,600	$ 6,500	**$ 2,900**
Instrumentation, Data Package	$ 800	$ 9,423	**$ 8,623**
Site Prep, labor materials	$ 925	$ 1,024	**$ 99**
Technical Supervision/Start-up	$ 6,500	$ 5,347	**$ (1,153)**
Total	**$ 82,825**	**$ 90,976**	**$ 8,151**

Annual Technical Services	**Budgeted**	**Actual**	**$/Hr**	**Budgeted**	**Actual**	**Variance**
Technical Services Maintenance/Hrs.	575	415	$ 75	$ 43,125	$ 37,350	$ (5,775)
Report Writing/Hrs	50	45	$ 100		$ 4,500	$ 4,500
Perdiem costs/days	56	83		$ 560	$ 938	$ 378
Travel Costs				$ 840	$ 1,660	$ 820
Performance Monitoring/Hrs.	96	15	$ 75	$ 7,200	$ 1,125	$ (6,075)
Decommissioning Site Restoration/Hrs	28	28	$ 75	$ 2,100	$ 2,100	$ -
Miscellaneous Decommissioning Costs					$ 255	$ 255
Total Services	**805**	**586**		**$ 53,825**	**$ 47,928**	**$ (5,897)**
Total Project & G+A				**$ 161,247**	**$ 163,907**	**$ 2,660**

Annual Operating Expenses	**Budgeted**	**Actual**	**$/Hr**	**Budgeted**	**Actual**	**Variance**
Natural Gas Mcf/ hr @ 2.5kW	0.0328	0.0351	$ 0.216	$ 1,704	$ 1,820	$ 117
Water Gallons per Year	14,016		$ 0.033		$ 32	**$ 32**
Natural Gas Cost/kWh			**$ 0.0864**			

Economic Summary	**Budgeted**	**Actual**	**Variance**
Forecast Annual kWH	19710	20696	986
Annual Cost of Operating Power Plant kWH	$ 0.0771	$ 0.0734	$ (0.0037)
Credit Annual Thermal Recovery kWH	$ (0.0110)	$ (0.0209)	$ (0.0099)
Project Net Operating Cost kWH	$ 0.0662	$ 0.0526	$ (0.0136)
Displaced Utility cost kWH	$ 0.0480	$ 0.0480	$ -
Energy Savings (Increase)	($0.018)	($0.005)	$ 0.0136
Annual Energy Savings (Increase)	($357.77)	($94.42)	$ 263.34

14.0 Milestones/Improvements

As mentioned above in paragraph 9, the fuel cell inverter in GenSys5C S/N 196, used during this project, is the newly introduced MP-5. This improvement added a gird independent operating capability to the basic grid parallel configuration found on the previous versions of the GenSys5 SU-1 platform. This capability is an important milestone in the development of the Gensys5 product and for the PEM Program itself, as it is a significant developmental step on the pathway to product commercialization. In this particular project, that capability allowed LOGAN to install an "emergency Load" panel at the host site and transfer several circuits to that panel. In the event of a utility failure these circuits would have remained energized by the fuel cell. The circuitry and functionality describing this can be seen in Figures 2, 3 and 4 above.

S/N 196 also took advantage of the capability to recover waste heat through the addition of a customer heat exchanger added to the unit for that purpose. Fuel cell heat was previously rejected through an air-cooled radiator on the unit, but the introduction of an extra heat exchanger allowed LOGAN to reject that heat to the host's hot water heater through a glycol loop. This process is more fully described in paragraph 10.0 above. With the help of a Heliodyne heat exchanger coil, the waste heat was more efficiently recovered for consumer applications. The Heliodyne design is made up of a coil within a coil, described in Figure 6, which provides double wall protection between the heat source and the heat sink in order to prevent contamination of potable water supplies. It was designed primarily for the solar heating industry, but proved to be very adaptable to this installation.

The U.S. Coast Guard S/N 196 also introduced the application of new web-based data acquisition technologies, with the help of Connected Energy Corporation. Because of problems obtaining a phone line in more remote/secure locations, LOGAN decided to experiment with a new web based, real time data-management and reporting system. The drawing seen in Figure 8 describes the architecture of the CEC system operating at the site and Figure 7 is a picture of the CEC system. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, remote notification, and reporting functions. CEC's Central Operations Control Center in Rochester, New York, collects, stores, displays, alarms, archives site data, and maintains connectivity with the site. More explanations and descriptions of the hardware and its functionality can be found in paragraph 11.0 above.

15.0 Decommissioning/Removal/Site Restoration

Fuel Cell Decommissioning and site restoration was completed on May 16, 2005 and took approximately 16 hours. All plumbing and heating systems and electrical circuits were restored to their original pre-test condition. This work was accomplished without any inconvenience to the occupants.

16.0 Additional Research/Analysis

In order to better assess the dependability and efficiency of the thermal recovery system, as well as many other features of the GenSys5C, LOGAN introduced Connected Energy's web-based data acquisition technology. With the help of this system, fuel cells in LOGAN's service fleet can be monitored via the internet and Connected Energy can provide real time data for almost any statistic of concern within the operating cycle of the GenSys5C.

The graphs in Appendix 1 show the fluctuation of several variables across S/N 196's entire first year of operation. The first graph shown is of the fuel cell's AC Output Power from its initial start date. The work logs in Appendix 3 should be referenced for periods of inoperability.

The second graph in Appendix 1 is of the fuel cell's CHP Loop Efficiency from its initial start date. Problems with the Connected Energy CHP sensors left a gap in the data for the first few months of S/N 196's operation, however technicians were able to correct the problem and began logging data in late February of 2004.

The third graph in Appendix 1 is of Heat Recovery Loop Inlet/Outlet Temperatures from its initial start date. The temperature difference between the inlet flows and outlet flows provides a better picture of how much and when heat is actually recovered at certain times of the day, month, or year. The delta between these temperatures can prove valuable in data analysis. The fourth graph in Appendix 1 is of Heat Recovery Flow Rate from its initial start date. For each of these plots, the variable units are listed at the bottom of each graph.

Appendix section 4 labeled, Harmonics Testing, presents site data gathered from testing and verification of performance specifications of the GenSys AC inverter. The data describes three conditions; a. stand alone grid harmonics, b. the inverter harmonics in a grid connected configuration, and c. inverter harmonics in grid independent configuration. The IEEE Standard, 519-1992, that governs the performance of the Plug Power inverter states that;

1. Total Voltage Harmonic Distortion at rated inverter output is limited to 5% of fundamental frequency voltage, and
2. Individual Frequency Harmonics Distortion is limited to 3% of fundamental frequency voltage.

Referring to the Chart in Appendix 4, the test results indicate that at the time the measurements were taken, no individual frequency Harmonic exceeded the IEEE standard of 3%, and that total Voltage Harmonic Distortion at 3.1% was well below the upper IEEE limit of 5%.

17.0 Conclusions/Summary

Installation of the Plug Power GenSys5c fuel cell power plant at the United States Coast Guard Station, New Orleans provided LOGANEnergy a unique opportunity to closely evaluate changes to the overall system as LOGAN has a field office just outside of New Orleans. As discussed earlier in the report, this site had several firsts and they included the new Plug Power MP5 inverter, the Connected Energy web based system, and the Heliodyne heat exchanger integrated into the thermal recovery system. The close proximity of the site allowed the field technician to quickly deal with several new issues that came up as a result of incorporating this new equipment. One of those issues which was a major lessons learned for LOGAN and the CERL PEM Program, was understanding the most effective way to provide high speed connectivity to the internet while operating on a secure military site. Installing a commercial DSL line turned out to be the most efficient, cost effective, and secure solution for the Coast Guard site. In today's world secure military facilities will not allow access to their internal LAN through an Ethernet connection because they see this as a major breach of security. This fuel cell site set the standard for fuel cell installations to come.

The Coast Guard project did encounter technical issues with the fuel cell that resulted in a lower than anticipated system availability for the first half the demonstration period and as a result the fuel cell operating period had to be extended to 6 months to recover the lost availability. It took several shutdowns and service calls before the attending field technician and Plug Power engineers could determine the root cause of the problem to be a failed level sensor in the Fuel Processing System ATO canister. Following replacement of the ATO canister the power plant was restarted and over the last 7 months of the project an availability level of 98% was achieved. Resolving this key issue will lead to a more reliable fuel cell product as well as enhanced system troubleshooting techniques.

Though the project approved by CERL amounted to $161,247, LOGAN provided an additional $2,260 in cost share to bring the project to a successful completion. The additional cost in large part was due to the first time use of the new web based SCADA equipment. Besides the this material cost, additional time was spent understanding how to wire in all the ancillary system sensors such as the gas and electric meter outputs as well as the thermal recovery temperature and flow sensors.

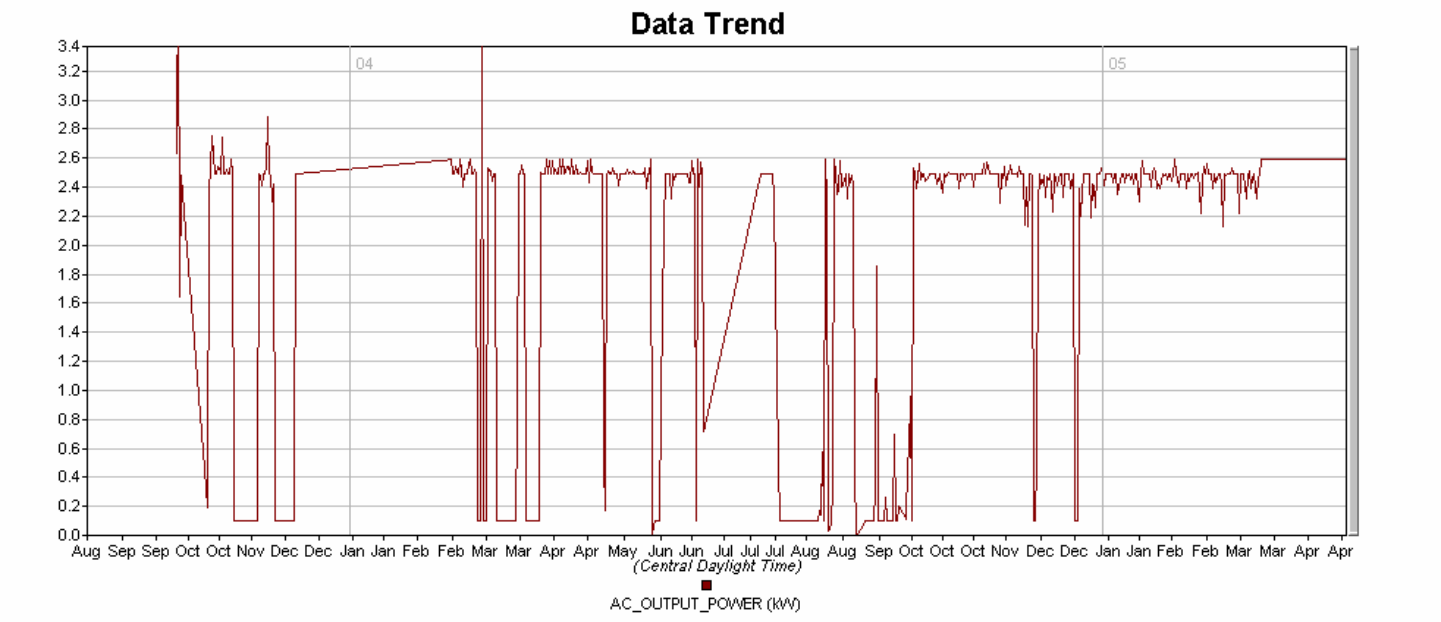
In summary, the lessons learned from this site will provide a positive impact for all future PEM fuel cell installations both within the CERL community and those outside of it. As with most projects in the CERL PEM Fuel Cell Program, this project has elevated the awareness of fuel cells within the Coast Guard and advanced the broader objectives of the fuel cell industry and product commercialization.

Appendix

1) Monthly Performance Data
2) Documentation of Installation Tasks and Acceptance Test
3) Daily Work Logs
4) FC Harmonics Test
5) Explanation of Program Costs

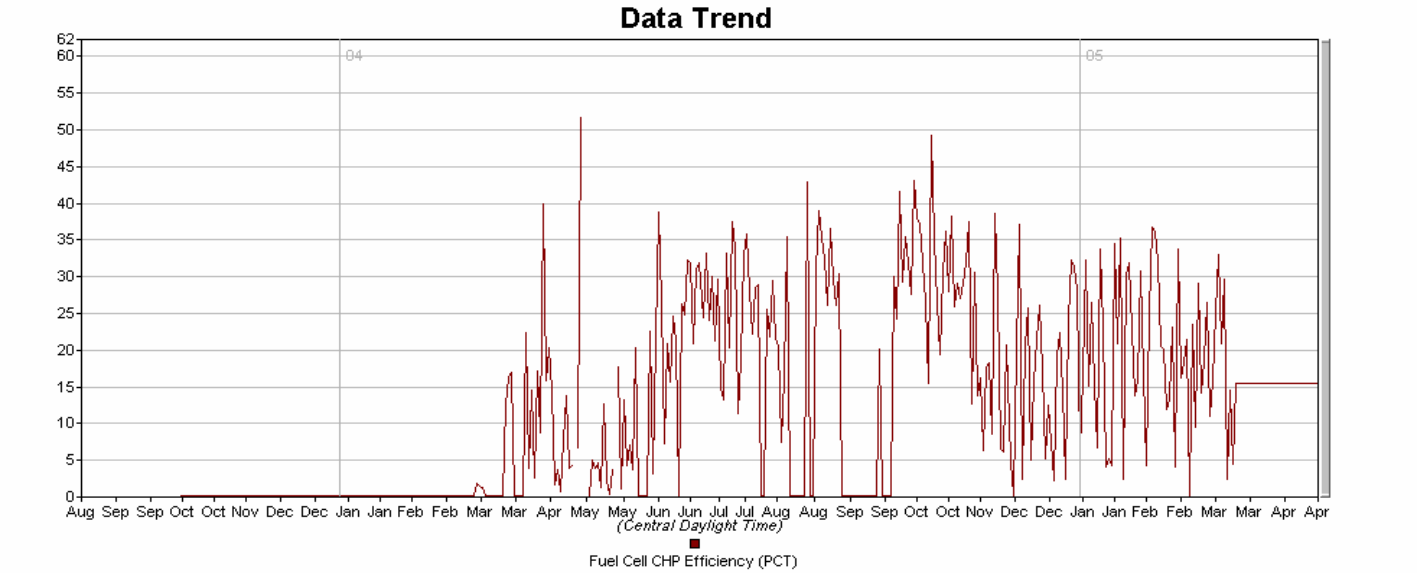
1) Monthly Performance Data

*AC POWER OUTPUT CHART, spanning an 18 month period, from initial start (August 27, 2003).

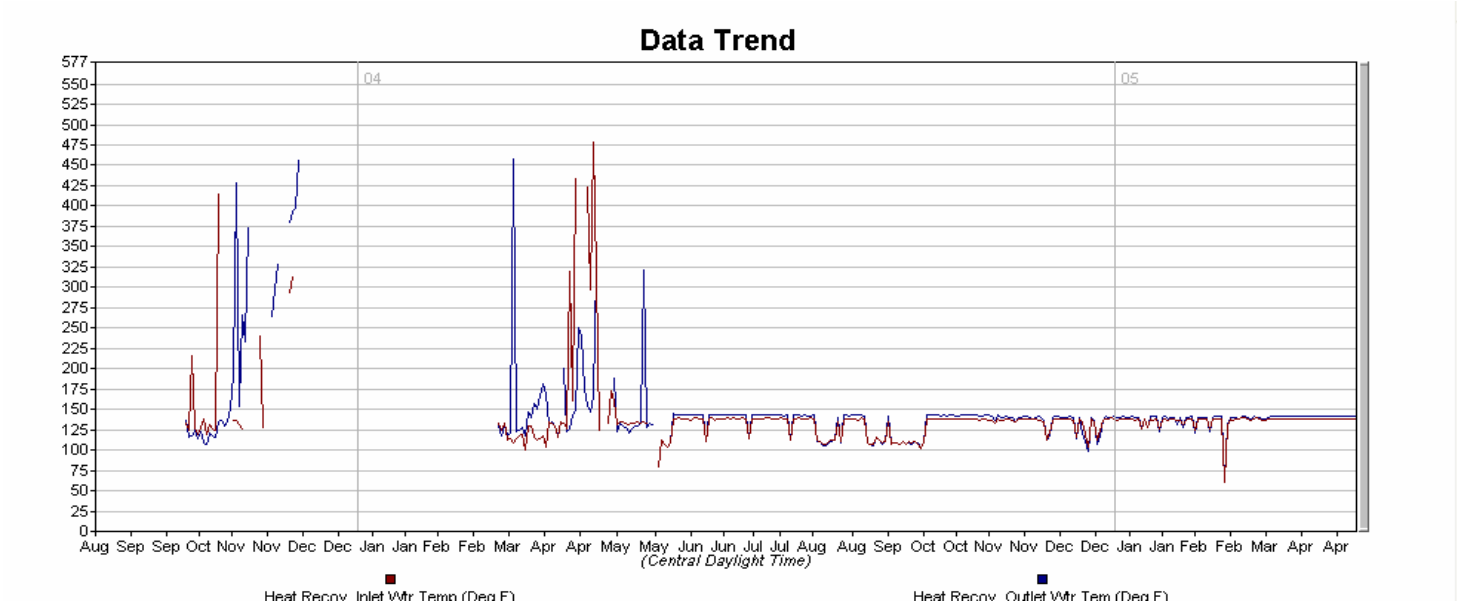


*See Work Logs in Appendix 2 for reference to periods of inoperability

*FUEL CELL CHP EFFICIENCY CHART, spanning an 18 month period, from initial start (August 27, 2003)

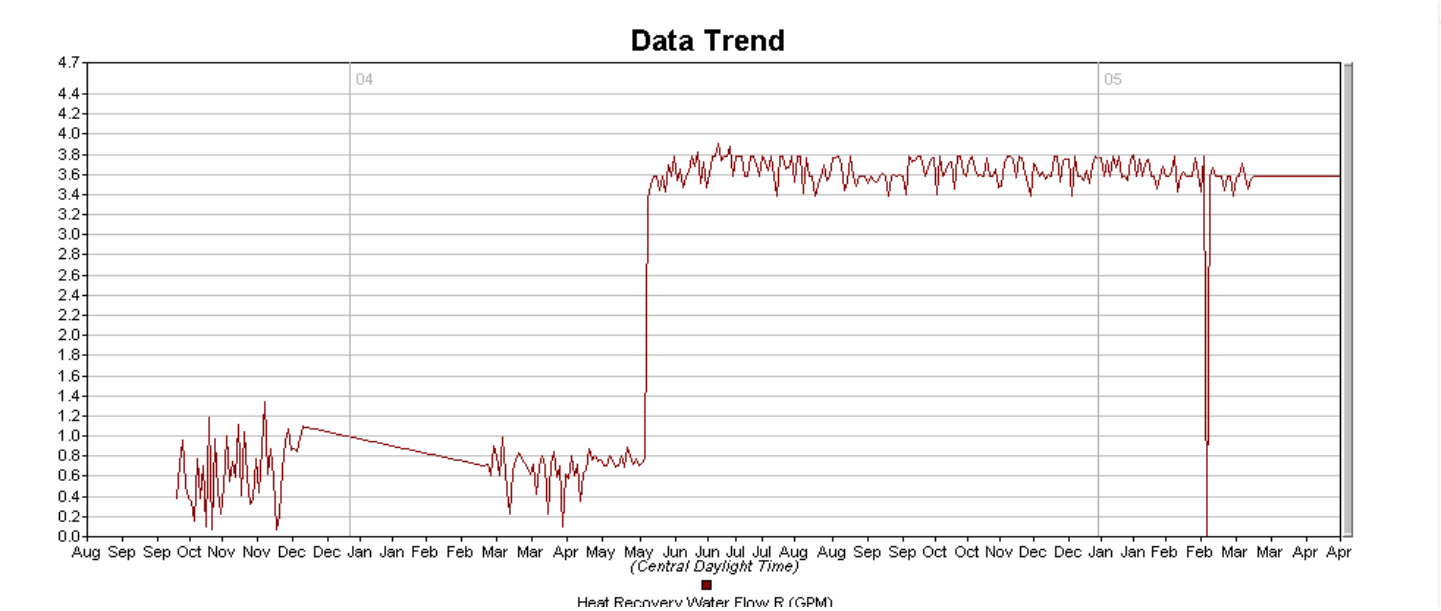


*HEAT RECOVERY INLET AND EXIT WATER TEMPERATURE CHART, spanning an 18 month period, from initial start (August 27, 2003)



*HEAT RECOVERY WATER FLOWRATE, spanning a one-year period, from initial start (October 22, 2003).

*See Work Logs in Appendix 2 for reference to periods of inoperability



*Monthly Fuel Cell Statistics:

	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04
Run Time (Hours)	172.0	628	685	578	277	696	566	652	480
Time in Period (Hours)	720.0	744	744	696	744	720	744	720	744
Availability (%)	24%	84%	92%	83%	37%	97%	76%	91%	65%
Energy Produced (kWe-hrs AC)	421.0	1544	1683	1697	714	1789	1414	1624	1205
Output Setting (kW)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Average Output (kW)	2.45	2.46	2.46	2.93	2.58	2.57	2.5	2.49	2.51
Capacity Factor (%)	49.0%	49.2%	49.1%	58.7%	51.7%	51.4%	50.0%	49.8%	50.2%
Natural Gas Usage, LHV (BTU's)	5.48E+06	2.03E+07	2.30E+07	1.84E+07	9.86E+06	2.42E+07	1.96E+07	2.27E+07	1.76E+07
Natural Gas Usage (SCF)	5418	20115	22779	18183	9752	23895	19399	22425	17434
Electrical Efficiency (%)	26.23%	25.91%	24.94%	31.50%	24.71%	25.27%	24.59%	24.43%	23.32%
Number of Scheduled Outages	0	0	0	0	0	0	0	0	0
Scheduled Outage Hours	0	0	0	0	0	0	0	0	0
Number of Unscheduled Outages	2	1	1	2	3	1	2	2	1
Unscheduled Outage Hours	548.0	116	59	118	467	24	178	68	264

	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05
Run Time (Hours)	265	36	733	696	681	744	672	744	720
Time in Period (Hours)	744	720	744	720	744	744	672	744	720
Availability (%)	36%	5%	99%	97%	92%	100%	100%	100%	100%
Energy Produced (kWe-hrs AC)	632	67	1804	1701	1668	1830	1661	1839	1861
Output Setting (kW)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Average Output (kW)	2.39	1.83	2.46	2.44	2.45	2.46	2.47	2.47	2.58
Capacity Factor (%)	47.8%	36.7%	49.3%	48.9%	49.0%	49.2%	49.4%	49.4%	51.7%
Natural Gas Usage, LHV (BTUs)	8.40E+06	1.15E+06	2.35E+07	2.25E+07	2.19E+07	2.47E+07	2.30E+07	2.60E+07	2.67E+07
Natural Gas Usage (SCF)	8307	1142	23203	22274	21683	24467	22748	25693	26401
Electrical Efficiency (%)	25.68%	19.69%	26.24%	25.78%	25.96%	25.25%	24.64%	24.16%	23.79%
Number of Scheduled Outages	0	0	0	0	0	0	0	0	0
Scheduled Outage Hours	0	0	0	0	0	0	0	0	0
Number of Unscheduled Outages	3	3	1	1	2	0	0	0	0
Unscheduled Outage Hours	479	684	11	24	63	0	0	0	0

2) Documentation of Installation Tasks and Acceptance Test

An 8-hour Acceptance test was run on August 27, 2003 by the technician following completion of all the commissioning tasks listed in the Checklist attached below. It was the first successful start-up of the system. Please see Appendix 3 for the documentation of the test done by the technician.

Installation Acceptance Test Report

Site: US Coast Guard Operations Center

New Orleans, LA

Installation Check List

TASK	Initials	DATE	TIME (hrs)
Batteries Installed	KW	8/6/03	2
Stack Installed	KW	8/6/03	4
Stack Coolant Installed	KW	8/7/03	1
Air Purged from Stack Coolant	KW	8/7/03	0.5
Radiator Coolant Installed	KW	8/7/03	3
Air Purged from Radiator Coolant	KW	8/7/03	1
J3 Cable Installed	KW	8/8/03	1
J3 Cable Wiring Tested	KW	8/8/03	0.5
Inverter Power Cable Installed	KW	8/8/03	0.5
Inverter Power Polarity Correct	KW	8/8/03	0.5
RS 232 /Modem Cable Installed	KW	8/8/03	0.5
DI Solenoid Cable Installed with Diode	KW	8/15/03	0.2
Natural Gas Pipe Installed	KW	7/1/03	8
DI Water / Heat Trace Installed	KW	8/15/03	2
Drain Tubing Installed	KW	8/15/03	1

Commissioning Check List and Acceptance Test

TASK	Initials	DATE	TIME (hrs)
Controls Powered Up and Communication OK	KW	8/22/03	4
SARC Name Correct	KW	8/22/03	1
Start-Up Initiated	KW	8/22/03	2
Coolant Leak Checked	KW	8/22/03	1
Flammable Gas Leak Checked	KW	8/22/03	1
Data Logging to Central Computer	KW	10/27/03	2
System Run for 8 Hours with No Failures	KW	8/27/03	8

3) Daily Work Logs
LOGANEnergy Field Technicians
(June 2003—September 2004)

LOGANEnergy Corp.
Monthly Site Report
Period **6/1/03**
Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	6/5/03		Met with Sam, Nick and Petty Officer Dunn to discuss installation and connections.
	6/6/03		Met with contractor at Coast Guard Station

LOGANEnergy Corp.
Monthly Site Report
Period **8/1/03**
Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	8/6/03	196	Worked with George to place fuel cell on site loaded new software and inverter set points
	8/7/03		Worked with George to fill p/p with fluids met with contractors
	8/8/03		Started installing flow meter and temp sensors
	8/15/03	196	Pulled wires for sensors
	8/22/03	196	Commissioned R/O system and started p/p ATO 2 sensor is bad but working data logging is working erratically
	8/27/03		Returned to site pleased to find p/p still running filled Heat recovery with glycol and started pumps
	8/29/03	196	P/p shutdown but cannot determine why because data logging not working suspect ATO 2 TC but need to resolve data issue before re-start

LOGANEnergy Corp.
Monthly Site Report
Period **9/1/03**
Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	9/3/03	196	Shutdown p/p awaiting phone line or network connection
	9/29/03	196	Worked with Mark Ginter from Connected Energy to hook up fuel cell to network

	9/30/03	196	Finished connection made cat5 line and plugged into CG network

LOGANEnergy Corp.

Monthly Site Report

Period **10/1/03**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	10/16/03	196	Went to site to start p/p SARC wouldn't power up Plug sending new PDB
	10/17/03	196	Installed new PDB still no success Plug sending new SARC
	10/24/03	196	Installed new SARC with same result but was able to jump K1 relay and power up SARC and start p/p
	10/27/03	196	Returned to site p/p still running verified connections with Connected Energy added Plug Power to Connected Energy call in list and commissioned the p/p

LOGANEnergy Corp.

Monthly Site Report

Period **11/1/03**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
	11/6/03		CGNO (installing Cat5 cable , worked with Mark Ginter for two days)
K Williams	11/7/03	196	PP is running. Jumped terminals 1 & 2 on the K1 relay and power up the SARC. Installed V 1.27 software but no power up.
			Shutdown to replace gas meter and update SARC software. Jumping out K1 powers up SARC
	11/16/03		SARC and PDB installed.
	11/17/03		Filled the DI tank to its max 127% and restarted PP.
	11/26/03		Check phone line for correct polarity and voltage, and that system data logging is set up properly. Called the system and setup data logging (System parameters were not setup). Received full data set on Saturday and Sunday but no data received today, will continue to monitor. Verified status via Connected Energy

			I reviewed the High speed data (attached) for B196. FC contactor is commanded closed but does not appear to actually be closed; FC voltage is following battery voltage, this is normal when the FC contactor is open but not when it is (should be) closed. The exhaust high SD was caused by excessive gas to the ATO that was not being consumed by the stack. Try powering off the system and restarting, if this does not work we will investigate the next course of action.

LOGANEnergy Corp.

Monthly Site Report

Period **12/1/03**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	12/5/03	196	Testing water issue. Changed filters…some iron contamination. Crimp in tube was restricting flow.
	12/8/03		Possible leak turned up negative. P/P is running fine.

LOGANEnergy Corp.

Monthly Site Report

Period **1/1/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	1/28/04	196	Shut down PP to load new 1.28 software and replaced the stepper motor. I made sure my set points were good and configured the data logging. Receiving alert "remote requested shutdown". Happens when a Connected Energy box cat5 cable is connected. With the system running, unable to connect via modem. Trip planned for Thursday to check PP.
	1/31/03		Checked the stepper motor. Shut the p/p down and removed the new stepper motor. I went to change the MCB and in doing so I found one of the wires connected to the terminal strip to be just hanging in its crimp. I installed the new MCB with the newly crimped wire, it worked. Turns out the stepper motor never worked. The problem that alerted him was not the stepper motor itself but some odd temperatures.

LOGANEnergy Corp.

Monthly Site Report

Period **2/1/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	2/4/04	196	Appears to be a problem with the stepper motor. Hiccup in the gas supply. Restarted the P/P
	2/5/04		This time its the ATO flow sensor and a MCB for the cathode blower. Rob and Gary are sending parts.

	2/6/04	I changed the mass flow sensor and the cathode MCB. Received "LTS SCR PROX" and had a "O2 CH4 high" shutdown. The next attempt shutdown with "ATO flow timeout". The next shutdown "recover cathode blower".
	02/07/04	I installed the new SARC but came across a low battery. Replaced battery and startup okay.
	2/18/04	System Status: Shutdown Incident Description: 2/16/2004 10:52:58 AM, SHUTDOWN, KW_CONTROL_FAILURE_SD, Error Code: (511) Incident Resolution: It appears that there may have been a drop in Natural Gas pressure. If there is no indication that there was a pressure drop or gas curtailment then inspect all gas and air hoses and connections in the reformer prior to restart.
	2/19/04	System Check

LOGANEnergy Corp.

Monthly Site Report

Period **3/1/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	03/01/04		System Status: Running
	3/5/04		Start up proceeded without incident. Called the p/p later and still running. That lasted till it shutdown Saturday with the same event. Will sniff it when it gets nice and hot to see if a crack is expanding and leaking gas.
	3/5/04		System Status: Shutdown Incident Description: 3/3/2004 11:31:13 AM, ESTOP, HW_ESTOP_FG3_L6, Error Code: (532) Incident Resolution: Keith Williams going to the site today.
	3/8/04		Installed the new gas meter. P/p start up. Cranked the p/p up to 4kw and sniffed one more time. I found no leaks. With modem installed. Website should be up today.
	3/8/04		System Status: Shutdown Incident Description: 3/3/2004 11:31:13 AM, ESTOP, HW_ESTOP_FG3_L6, Error Code: (532) Incident Resolution: Keith restarted the unit on Friday (3/5) but it shutdown ~26 hrs later for the same error. Heat expansion may be causing gas leak or there may be a loose wiring connection or a faulty sensor. Keith is returning to the site today.
	3/12/04		System Status: Running – requires maintenance Maintenance: DI solenoid (SOL2) is cycling only twice per day. This is an indication that the fill rate is very slow and could cause a shutdown soon.
	3/15/04		System Status: Running – requires maintenance Maintenance: DI solenoid (SOL2) is cycling only twice per day. This is an indication that the fill rate is very slow and could cause a shutdown
	3/18/04		System Status: Shutdown Maintenance: Keith Williams is waiting for access to base to check DI water system – Post Inspection is denying access to civilians.

	3/21/04	Changed out the filters and saturated the R/O. After I adjusted flow I started the p/p. P/P ok set to 2.5kw.
	3/22/04	System Status: **Shutdown... CG Security alert no access to base.** Maintenance: Keith Williams is waiting for access to base to check DI water system – Post Inspection is denying access to civilians.
	3/31/04	System Status: **Shutdown...CG Security alert no access to base.** Incident Description: 3/26/2004 8:22:02 AM, Running (51) ESTOP, HW_ESTOP_FG3_L6, Error Code: (532)

LOGANEnergy Corp.

Monthly Site Report

Period **04/01/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
	04/01/04		System Status: **Shutdown** Incident Description: 3/26/2004 8:22:02 AM, Running (51) ESTOP, HW_ESTOP_FG3_L6, Error Code: (532)
	04/02/04		System Status: **Shutdown** Incident Description: 3/26/2004 8:22:02 AM, Running (51) ESTOP, HW_ESTOP_FG3_L6, Error Code: (532) Incident Resolution: 3rd occurrence of this shutdown on this system, replace FG3 sensor and restart, Keith has new sensor.
	04/05/04		System Status: **Shutdown** Incident Description: 3/26/2004 8:22:02 AM, Running (51) ESTOP, HW_ESTOP_FG3_L6, Error Code: (532) Incident Resolution: 3rd occurrence of this shutdown on this system, replace FG3 sensor and restart, Keith has new sensor.
	04/06/04		Installed new hydrogen (fg3) sensor and restarted the p/p power was set at 4kw for 2 hours then reduced to 2.5 where it sits FG3 sensor was causing a e-stop possible cause was the Coast Guard starting the engines of one of their boats directly under the fuel cell the sensor has been known to fail or cause shutdowns if a rich mixture of engine exhaust is allowed to enter the fuel cell this is what was present I requested they move their engine work to an area down wind of the fuel cell with that done and the new sensor installed the fuel cell is running Site access during this time was poor resulting from base wide inspections and preparations for them which lasted for 2 weeks unit was started remotely a number of time during this time but they ran the engine at the same time every day which coincided with a shutdown shortly thereafter

LOGANEnergy Corp.

Monthly Site Report

Period **5/4/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
	5/3/04 5/4/04		COMSYS detected the following alarm: System Status: **Shutdown** Incident Description: 5/3/2004 4:48:09 PM, Running (51) SHUTDOWN, TC1_CPO_HIGH_SD, Error Code: (258) Incident Resolution: Looks like the NG supply to the unit was shut off or curtailed. If no evidence of NG supply issues at site then inspect SOL1AB and SOL14AB for proper operation.
K Williams	5/4/04		P/p shutdown with a FS7 estop. I cleaned the filter and rebooted the p/p and it started right up. I will fill out the work log from the VPN. While onsite I tightened the connections on the RDTs and they are now reading correctly. I believe rain water gets into the plugs and causes corrosion and subsequent loosening. I taped the connections and hopefully this will solve the problem. I won't use this type RDT outside anymore.
			P/p shutdown with a FS7(cabinet ventillation) issue -the problem was a clogged intake filter which I cleaned and restarted the p/p
K Williams	5/18/04	196	met with Chris Leblanc of National instruments to talk about an alternative to Connected Energy and t/sed the RDT problem I may have to replace the RDTs with something more suited for the environement
K Williams	5/20/04	196	site btu readings are off went to site to t/s found RDTs not reading correctly cleaned the connections looks good
	5/21/04	196	returned for same issue decided to try making direct connections by soldering wires direct to the RDTs wires from the RDTs crumbled and broke Now that the problem is identified I need new RDTs
	5/24/04		Installed new RDTs but could not verify if they were working temps were not registering on website
	5/25/04		Worked with Mark Ginther over the phone and corrected RDT issues but flow meter stopped working
	5/26/04		In an effort to t/s flow meter issue I connected my transfer pump to the inlet and outlet sides of the loop and started pumping I had erratic flow so I connected the inlet to the pump to the hose and pumped in some water and everything started to work
	5/27/04		COMSYS detected the following alarm: ALARM: Fuel Cell B196 Shutdown ALARM TIME: May 27 2004 5:28AM CDT EQUIPMENT: Plug Power Fuel Cell SITE: 4th District Coast Guard Center

			System SU01B000000196 shut down.
	5/28/04		This is an automatically generated email. If you do not wish to be notified when system SU01B000000196 shuts down, please respond to this email indicating that you wish to be removed from this list.
	5/29/04		System SU01B000000196 shut down. This is an automatically generated email. If you do not wish to be notified when system SU01B000000196 shuts down, please respond to this email indicating that you wish to be removed from this list.
Worley	5/27/04	196	Travel form Augusta to Atlanta
Worley	5/28/04	196	Thursday - Flight from Atlanta to New Orleans
Worley	5/29/04	196	Friday - Picked up rental car, picked up parts at FedEx station. Installed new parts and restarted unit. Unit went into running mode around 6:00pm local time. Shut down less than one hour later due to SARC I2C comm. Fault Error codes 106 & 107. Saturday - Changed flight arrangements and went back to site. Completely powered unit down and removed battery cable. Restarted. Unit left in SCR PROX WARMUP. DI tank 126%. Left site to make 1:38pm flight. Travel from Atlanta airport to home
K Williams	5/31/04	196	arrived at site after Jeff had changed E-wheel, filters and performed 12,000 hour maintenance but could not re-start p/p- data logging configuration was gone but batteries metered good- loaded 1.29 software- added Therminol and Glycol- kept getting remote requested shutdown

LOGANEnergy Corp.

Monthly Site Report

Period **6/1/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
	6/1/04		System Status: **Shutdown** Incident Description: losing its memory Incident Resolution: System was restarted but shutdown again. Keith was having problems with “remote requested shutdown” during startup. Enables setpoints were not holding when system was powered down. He will try a new battery for the SARC memory and then replace the SARC if necessary
	6/1/04	196	returned to site and found setpoints were not staying- replaced SARC ROM battery and re-enabled setpoints and data logging- powered down and then after power up went for start- P/p shutdown after timing out in "Stack Health 2"- stack looks bad

6/2/04	picked up new stack from FEDEX with Tripp and went to Coast guard to install- upon arrival found p/p running- Rob had initiated a start remotely to make the change out easier for us but the p/p actually started- turns out the E-whell took longer than anticipated to re-hydrate- stack looks good
6/18/04	Arrived to find cathode blower, ato blower, pumps, ect. not functioning. Replaced PDB. No change. Replaced SARC with the one I removed from 250 Stennis. Was able to communicate with it long enough to initiate start. Remote comm goes bad on this SARC after about 1 minute but when I left the site it was still in start up according to the LEDs. I have been unable to call the p/p so far but will keep trying. Rob is sending a new SARC and I will replace it Monday morning unless it calls in and then I will replace it at next shutdown.
6/21/04	replaced SARC with new one and restarted p/p
6/21/04	Tripp and I arrived at the Coast Guard this morning and put in the new SARC. The p/p had been running since I restarted it Friday using the SARC I pulled out of 250. The only problem was the one I took out of 250 would only allow about 3 minutes worth of communication while plugged into it and no communication via modem. The comm worked long enough to hit the start button which is all 196 needed to get back on track and keep its availability up. It now fat , dumb and happy with its new SARC.
6/29/04	We thought we would lucky and get 250 started today also but it was not to be. We kept timing out during purge. For some unknown reason this p/p had water back up into the fuel/air system. We kept removing parts and blowing the water out and finally after disassembling the gas block and drying it completely we got past the purge. We then timed out on CPO heat up. Temp never got past 99 degrees C so I figured it was wet and I would keep trying till it dried out. Two attempts later and it heated right up. Once it got past that and into ATO lean stabilize we shutdown again on a "low reformer air". It took a couple more tries before I realized that the sensitivity was still at 1 and not .1. I thought it defaulted back when you hit the start button but once again today I was wrong. With that fixed we got to Lts SCR Prox and we looked like we were rolling along, i.e. CPO temps good ,ATO lit and temps good, LTS temps rising slow but rising. Then I get a O2 ch4 stoick low shutdown.! The only thing I noticed was in LTS SCR PROX the cathode blower never came on. I attributed this to the p/p being a LPG and I wasn't familiar with the sequence for these yet. Since I have no phone line there yet I decided to call it a day and go back when I have communications and I will be able to leave it running if I am lucky enough to stumble across how to do that.
	System Status: Running

Maintenance: Cathode Inlet temp is 2 degrees less than Stack coolant inlet temp. This will drastically affect stack life. E-wheel needs to be inspected and possibly replaced.

LOGANEnergy Corp.

Monthly Site Report

Period **7/1/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
K Williams	7/6/04		p/p did not call in since 7/2 cathode inlet temp is 2 degrees higher than stack coolant inlet. When I arrived at the site p/p was still running I did a mpdem test and it passed I confirmed this with Plug and they saw it come across. I inspected the E-wheel and found the drain plugged i removed this and the temperatures changed immediately
	7/8/04		change made Tuesday didn't last Chris sent a new E-wheel and I installed it and restarted the p/p it looks fine so far
	7/12/04		System Status: Unknown Incident Description: Cathode Inlet temp is 2 degrees less than Stack coolant inlet temp. This will drastically affect stack life. E-wheel needs to be inspected and possibly replaced Incident Resolution: Keith was at the site yesterday and found the e-wheel drain plugged. He cleared the blockage and the temperatures changed almost immediately; Cathode inlet was about 1degC higher than stack coolant inlet. The change was only temporary; after about 30 minutes the temps went back to 2 degrees negative. It's possible that the drain plugged again or that the e-wheel was damaged from running with a plugged drain. The e-wheel needs to be replaced; George Collard has a new spare that he found in one of the mechanical rooms in San Diego, he will ship it to Keith. After replacement, inspect old e-wheel for any visual signs of damage; restart the system and monitor into running to verify that the cathode delta is positive. System has not called in since 7/8/04; I will try to dial the system later today.
	7/15/04		System Status: Running Incident Description: System has not called Plug Power since AM 7/8/04. I dialed up and connected to it to check data logging, it all appeared to be set up properly but I stepped through the wizard anyway. It's still not calling.
K Williams	7/20/04		196 has decided not to call in anymore. If you look at the Connected Energy site ,at first glance, all appears fine. That is until you check out the new connectivity boxes which show that we are connected to the site but not to the fuel cell. We are still reading heat recovery and a visit to the site confirms the p/p is still running but I was unable to get it to call out. I have tried numerous times to call it but have been equally unsuccessful. I have requested another SARC, possibly one with the updated driver to resolve the modem issue and the Connected Energy problem. Chris is already sending a new MCB for the cathode blower. Ideally I could install both tomorrow and finish the "Lady by the Sea" for a while.

C Ashley	7/20/04	The new software is not released yet. I'll check on its status and give you an update tomorrow. As soon as its available we'll get a board burned and send it to you. Until then, we'll have to deal with the comm issue I guess.
	7/21/04	System Status: Running Incident Description: System has not called Plug Power since AM 7/8/04. I dialed up and connected to it to check data logging, it all appeared to be set up properly but I stepped through the wizard anyway. It's still not calling. Test version of software to fix Connected Energy issues will be available on Monday.
	7/26/04	System Status: Running Incident Description: System has not called Plug Power since AM 7/8/04. I dialed up and connected to it to check data logging, it all appeared to be set up properly but I stepped through the wizard anyway, it's still not calling. Test version of software to fix Connected Energy issues will be available today. I will send it to Keith ASAP.
	7/28/04	System Status: Running Incident Description.: Installed new SARC with 1.30 software loaded. System is running and also called in this morning but still have problem communicating with Connected Energy. Will try reflashing software.
K Williams	7/28/04	I installed the new style SARC. The fuel cell ran fine but we were unable to access it via Connected Energy. At the same time it stopped calling in to Plug. I was able to determine it still running by site visits and thermal recovery on the Connected site. This week I loaded a beta release of software designed to correct the Connected issue. Day 1with new software wasn't encouraging. Fuel cell ran fine but still no Connected Energy. I wasn't able to get the Modem to test successfully until the 3rd try.
	7/29/04	System Status: Running Incident Description.: Installed new SARC with 1.30 software loaded. System is running and also called in this morning but still have problem communicating with Connected Energy. Will try reflashing software. Reflashing software appears to have fixed some issues, but system shutdown last night. Will restart today.
	7/29/04	Day 2 I re-loaded the software and verified that we were now reading on Connected Energy. I still had troubles with the modem tests but again was successful the 3rd or 4th try. P/p got to "Stack Health 2" and the weather got bad. I picked up and headed to the house where I figured I would monitor it over the phone or with Connected Energy. Connected Energy showed Thermal recovery but no fuel cell. Dialing in was un-successful. I did get a shutdown notice this ! evening with the events log showing it finally timed out in "Stack Health 2". It is obviously calling out now. I still can't call it or get info from it from Connected Energy. I'll try to get it started again in the morning but these connection problems need to be corrected. I also installed a new cathode air blower that seemed to correct temperature issues

With all that said the fuel cell is running but still will not pass a modem test. Dave was unable to call it. It is not reading on the Connected Energy site anymore although it was yesterday. Is it possible that after it shutdown yesterday and called out regarding the shutdown it locked up the comm to the Connected Energy? Although I did power it down completely today which has been a way to reset the comms I did not attempt to reload the software which may have helped. Dave is sending a new SARC so all this may be academic but I am willing to try anything I can before I change the SARC to gather t/sing info. Let me know.

LOGANEnergy Corp.

Monthly Site Report

Period **8/4/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
	8/2/04		System Status: **Running – Requires Maintenance** Incident Description: Installed new SARC with 1.30 software loaded. System is running but it is not calling out and I cannot connect to it remotely, the modem answers but sounds strange and does not communicate. Possibly a modem problem, will try another SARC.
	8/9/04		replaced SARC in an effort to correct comm problems it only made them worse Plug is deciding what to try next system is running although we cannot talk to it
	8/11/04		Incident Description: Installed new SARC with 1.30 software loaded. System is running but it is not calling out and I cannot connect to it remotely, the modem answers but sounds strange and does not communicate. Possibly a modem problem, will try another SARC. Still working software issue for new design SARC boards.
	8/12/04		visited site to verify p/p status running
	8/14/04		visited site to verify p/p status running
	8/16/04		p/p shutdown on low dc voltage restarted
	8/18/04		found old style SARC over weekend and installed it with new 1.30 software and restarted having ATO problems possibly sulphur breakthrough
	8/19/04		Replaced desulph and restarted stack not producing enough dc volts will replace stack all comms now working
	8/20/04		replaced stack and p/p is running
	8/23/04		p/p shutdown on hum top high turns out I had sediment filters with too good a micron rating and they were clogging up replaced with correct one and restarted all comms fine p/p running fine

LOGANEnergy Corp.

Monthly Site Report

Period **9/4/04**

Site US Coast Guard NOLA

Engineer	Date	PP S/N	Activity
C Ashley	9/3/04	196	p/p shutdown looks like it is not exporting ac cannot communicate with it can't visit because of rain will try tomorrow
	9/4/04		Replaced SARC with one from Stennis p/p no modem but it has local comms restarted p/p
	9/10/04		Site visit showed shutdown this morning with Hum top high restarted
	9/13/04		p/p shutdown again with hum top high restarted and met with cable guy and found out cable modem doesn't take the heat but he installed a new one and after repeated attempts modem is at least calling out
	9/14/04		p/p shutdown again with hum top high but won't be able to get back to it until after hurricane Ivan passes
	9/16/04		System Status: Shutdown, No communication via phone line. Connected Energy is updating Incident Description: S/D for hum top high while running, recurrent problem with this system. Incident Resolution: Collected data from Connected Energy but I don't see any abnormalities, forwarded to Engineering for a second opinion. Most likely cause of hum top high S/D's is usually a bad hum level sensor or hump pump and/or hum pump MCB. System is idle until Ivan passes.
	9/22/04		System Status: Shutdown, No communication via phone line. Connected Energy is updating Incident Description: S/D for hum top high while running, recurrent problem with this system. Incident Resolution: Hum pump MCB was replaced but SD again for hum top high. Keith at the site today will try to collect some hi-resolution data.
	9/28/04		System SU01B000000196 shut down. This is an automatically generated email. If you do not wish to be notified when system SU01B000000196 shuts down, please respond to this email indicating that you wish to be removed from this list. 1096406603,9/28/2004 5:23:23 PM,Manual (20)SHUTDOWN, HUMIDIFER_TOP_HIGH_SD, Error Code: (248)(0) 1096406603,9/28/2004 5:23:23 PM,SD Ref Cool (104)EVENT, SHUTDOWN_EVENT, Error Code: (1001)(0)
	9/29/04		System SU01B000000196 shut down. This is an automatically generated email. If you do not wish to be notified when system SU01B000000196 shuts down, please respond to this email indicating that you wish to be removed from this list.

1096483483,9/29/2004 2:44:43 PM,Manual (20)SHUTDOWN, HUMIDIFER_TOP_HIGH_SD, Error Code: (248)(0)
1096483483,9/29/2004 2:44:43 PM,SD Ref Cool (104)EVENT, SHUTDOWN_EVENT, Error Code: (1001)(0)

9/30/04

System SU01B000000196 shut down.

This is an automatically generated email. If you do not wish to be notified when system SU01B000000196 shuts down, please respond to this email indicating that you wish to be removed from this list.

1096574012,9/30/2004 3:53:32 PM,SD Ref Cool (104)ESTOP, HUMIDIFER_TOP_HIGH_ESTOP, Error Code: (249)(0)
1096574016,9/30/2004 3:53:36 PM,ESTOP (107)ESTOP, HW_ESTOP_SARC_L0, Error Code: (534)(0)

LOGANEnergy Corp.			
Monthly Site Report			
Period	October-04		
Site	US Coast Guard NOLA		
Engineer	**Date**	**PP S/N**	**Activity**
	10/1/2004		7:30 Friday night
			196 is running and looking pretty good.
			I arrived at the site this morning and went to change the hum level sensor and realized I had a DI sensor instead. Back to the house to search through parts in hope of having the right part. Luckily in an unopened box from who knows when was the right sensor. Back to the CG. I put the new sensor in and verified its operation using the Expert version of service interface software (Brian, I have not forwarded this to the rest of my group because you asked me not to but several times while working with your guys over the phone they have asked me to use it to do tests that are not possible using the regular version. Please reconsider distributing the expert to all of us.)
			The p/p has now only 3 hours reduction left before I can start it.
			Yan and Shannon were able to analyze the data I collected and come up the hum level sensor not working. This problem persisted for too long because we did not have communication with the fuel cell. CE comms would not have helped in this area. Plug and Logan comms need to be a priority before anything else.
			The level sensors are delicate. There is a thin walled glass tube inside and it is easily damaged by shock. I would like to suggest that they not be shipped installed in the ATO can but packaged separately. I spent 4 days looking elsewhere because I assumed the level sensor was good since it was brand new. That is my fault and I have learned from this.
			I am going to hit the start button as soon as reduction is finished and should be able to close this out by this evening.

LOGANEnergy Corp.			
Monthly Site Report			
Period	November-04		
Site	US Coast Guard NOLA		
Engineer	**Date**	**PP S/N**	**Activity**
	11/28/2004		ALARM: Fuel Cell B196 Shutdown
			ALARM TIME: Nov 28 2004 2:54PM CST
			EQUIPMENT: Plug Power Fuel Cell
			SITE: 4th District Coast Guard Center
			1101668540,11/28/2004 2:02:20 PM,Running (51)ALERT, LEVS3_DI_TANK_LOW_ALERT, Error Code: (351)(0)
			1101675018,11/28/2004 3:50:18 PM,Running (51)SHUTDOWN, HUMIDIFER_TOP_HIGH_SD, Error Code: (248)(0)
			1101675018,11/28/2004 3:50:18 PM,SD Ref Cool (104)EVENT, SHUTDOWN_EVENT, Error Code: (1001)(0)
			1101675023,11/28/2004 3:50:23 PM,SD Ref Cool (104)ESTOP, HUMIDIFER_TOP_HIGH_ESTOP, Error Code: (249)(0)
Harvell	11/30/2004		Hum Top High Event
			Changed water filters in DI panel.

LOGANEnergy Corp.			
Monthly Site Report			
Period	December-04		
Site	US Coast Guard NOLA		
Engineer	**Date**	**PP S/N**	**Activity**
	12/18/2004		COMSYS detected the following alarm:
			ALARM: Fuel Cell B196 Shutdown
			ALARM TIME: Dec 18 2004 12:01PM CST
			EQUIPMENT: Plug Power Fuel Cell
			SITE: 4th District Coast Guard Center
	12/19/2004		replaced filters found water pressure low due to weather restarted p/p

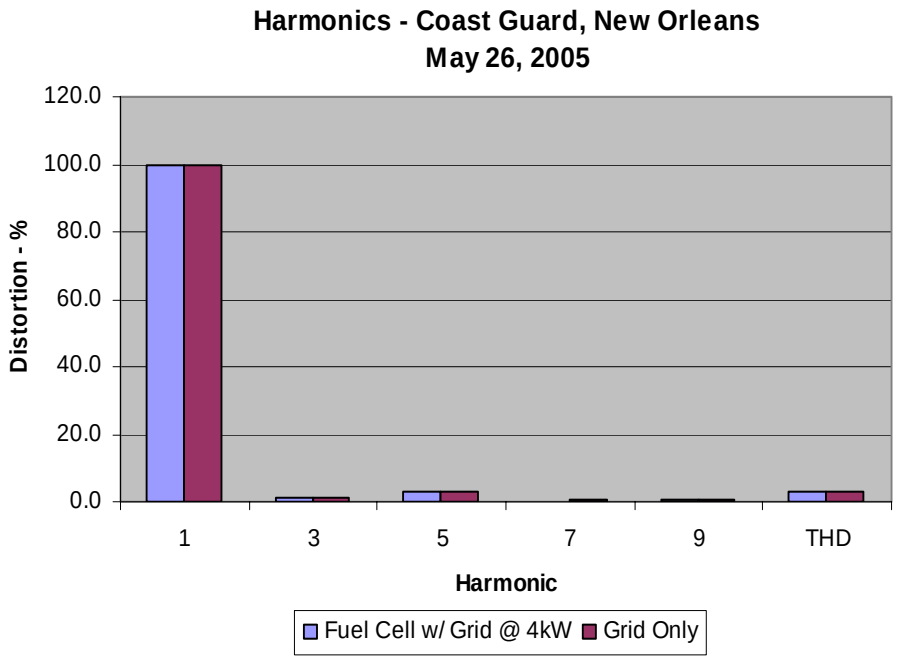
LOGANEnergy Corp.			
Monthly Site Report			
Period	January-05		
Site	US Coast Guard NOLA		
Engineer	**Date**	**PP S/N**	**Activity**
Williams	1/8/2005		Low DI level
			replaced filters found water pressure low due to weather restarted p/p

LOGANEnergy Corp.			
Monthly Site Report			
Period	March-05		
Site	US Coast Guard NOLA		
Engineer	**Date**	**PP S/N**	**Activity**
Williams	3/21/2005		The cable modem at the Coast Guard has gone out again. Cox Cable has already replaced it once and says they will have to charge us for a new one to replace this one as they warned me last time that their modems aren't designed for extreme duty, i.e. temperature swings. This fuel cell is close to finishing it time and although still running we haven't recieved any CE data since last Thursday. The cable company says they can get someone out to replace the modem, if we want to pay for it, sometime next week. I think we should let the fuel cell run until it shuts down and then decommission it and not worry about the cable modem at this time. Let me know how you guys want me to proceed.

4. Harmonics Test

The data box and resultant graph below depict the test parameters and the resultant distortion of the 1st through 9th harmonics of GenSys S/N 196 captured during a test conducted on May 26, 2005 with an Amp Probe HA-2000 Harmonics Analyzer.

Coast Guard, New Orleans Harmonics Data					
Date	5/26/2005		Time	9:15am	
			Tech:	Williams	
Fuel cell	4.0	kW	Off		
Grid Present	Yes		Yes		
Harmonic	Volts	Percent	Volts	Percent	
1	121.5	100	120.4	100	
3	1.084	1.0	1.280	1.2	
5	3.725	2.9	3.920	3.0	
7	0.173	0.1	0.545	0.4	
9	0.555	0.4	0.458	0.3	
THD		3.10		3.27	



The test results indicate that Plug Power GenSys S/N 196 inverter was performing at a level consistent with the manufacturer's specifications.

5. Explanation of Program Costs

Explanation of Calculations:

Program costs may be broken down into three broad categories as illustrated in the chart above. They are **First Cost**, **Annual Technical Services**, and **Annual Operating Expenses**. The first category labeled **First Cost** has been further delineated into two columns labeled **Estimated** and **Actual**. The estimated and actual costs draw a distinction between those construction/installation costs originally **Budgeted** for the project as opposed to the **Actual** costs to complete the project. In this case, the **Actual** project **First Cost** was $599 less that the amount originally **Budgeted**. While the electrical installation portion of the project cost less than originally supposed, the increase in the mechanical and thermal recovery line item more than offset the savings in the electrical cost category. Since the installation encountered fewer technical issues than originally considered, and since the initial start-up went smoother than planned, the Technical Supervision/Start-up line item cost less than the budget amount

The category labeled **Annual Technical Services** breaks out several categories of costs and expenses that were required to support the project for the test period. The **Variance** in this category amounted to $4,802 dollars less than originally budgeted. The primary reason for this **Variance** was due to the unit requiring fewer hours to support than originally **Budgeted** for service and maintenance costs. However, report writing was not originally **Budgeted** as a project line item and appears as a large **Variance** to the original budget.

The last category labeled **Annual Operating Expenses** breaks out the fuel cell operating costs for the test period.
The **Budgeted** cost of natural gas consumed during the project was calculated on operating the fuel cell system at 2.5 kW thereby consuming 0.033 Mcf per hour natural gas. That cost per hour is $0.19 Mcf per hour *x* the cost of natural gas to USCG per Mcf at $5.80. The cost per year at $1501.59 is the cost per hour at $0.19 *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability. This cost may also be expressed as $0.0762 per kWh produced by the fuel cell.
The **Actual** cost of natural gas for the program came to $1604 or a **Variance** of $103 dollars. This was due to the increase in operating hours and to a slightly higher than projected hourly fuel cell consumption rate to .0351Mcf/h from .0328Mcf/h.
Natural gas fuel cell systems set at 2.5 kW will consume 1.6 gallons of water per hour through the DI panel. The total volume of water consumed at 14,016 gallons per year is 1.6 gph *x* 8760 hours per year. The cost per year at $18.36 is 14,016 gph *x* cost of water to USCG at $1.31 per 1000 gallons.
The **Budgeted** Total Annual Operating Cost, $1520 is the *sum of* the cost per year for the natural gas and the cost for the water consumption. The **Actual** costs follow as a result of data collected during the project.
Economic Summary:
The Forecast Annual kWh **Budgeted** at 19,710 kWh is the product of 2.5 kW set point for the fuel cell system *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability. The actual project kWh has been entered in the column labeled **Actual** with the forecast **Variance** in the column to the right.
The Annual Cost of Operating the Power Plant at $0.077 per kWH was **Budgeted** by calculating the Total Annual Operating Cost at $1520 *divided by* the forecast annual kWh at 19,710 kWh. The **Actual** cost was calculated using the real program results
The Credit for Annual Thermal Recovery of $0.018/kWH was **Budgeted** by calculating 7800 BTU per hour thermal recovery at 2.5 kW *divided* by 3414BTU/kWh *multiplied* .20 recovery factor, *multiplied* by $0.039/kWh. As a credit to the cost summary, the value is expressed as a negative number. The **Actual** value of thermal recovery was calculated using the Btu data captured during the project and has been expressed as a credit to the project. The **Variance** is expressed in KWh.
The **Budgeted** Project Net Operating Cost is the *sum* of the Annual Cost of Operating the Power Plant *plus* the Credit Annual Thermal Recovery. The **Actual** Operating Cost is similarly calculated.

The Displaced Utility Cost is the kWh cost of electricity paid by the U.S. Coast Guard. The original **Budgeted** and the **Actual** results are contrasted in the two labeled columns.
Energy Savings (cost) equals the Displaced Utility Cost *minus* the Project Net Operating Cost.
Annual Energy Savings (cost) equals the Energy Savings *x* the Forecast Annual kWh.